

Transportation  
Safety and  
Mobility

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**Project Title:**

Coordination of Freeway Ramp Meters and Arterial Traffic Signals Field Operational Test

**Task Number:** 2223

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**Product Category:** New or improved decision support tool, simulation, model, or algorithm (software)

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## Reducing Onramp Bottlenecks with Coordinated Signals

*Coordinating freeway ramp meters and arterial traffic signals improves traffic flow*

### WHAT WAS THE NEED?

Arterial intersection traffic control maximizes flow by progressively coordinating traffic signals over a series of intersections. Conversely, freeway entrance ramp traffic control maximizes mainline flow by restricting traffic from entering the highway if the total demand (upstream mainline flow + expected entrance ramp flow) approaches or exceeds the capacity of the downstream mainline section. Another conflict is that arterial intersection traffic control groups vehicles into platoons, while freeway entrance ramp metering tends to break these groups into individual vehicles, usually one vehicle per green light. If an entrance ramp is at capacity, either through high arterial demand or low entrance ramp discharge, traffic can spill back into the arterial, exacerbating the situation. In current traffic operating practice, traffic control at freeway entrance ramps and arterial intersections are operated independently. This lack of coordination reduces performance on both roadways because they are interconnected. To improve overall system performance, balancing these two variables is critical.

### WHAT WAS OUR GOAL?

The goal was to develop a strategy for coordinating freeway entrance ramp meters and arterial intersection traffic signals to optimize traffic flow and the performance of the overall system.



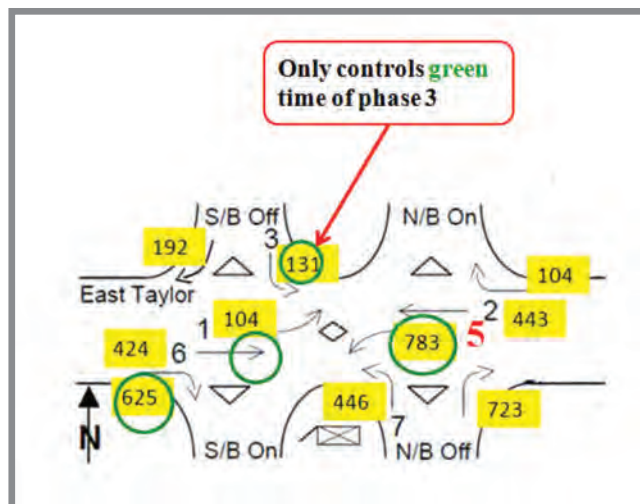
*Taylor Street intersection at State Route 87 in San Jose was used to test coordinating arterial traffic signals with freeway ramp metering.*

## WHAT DID WE DO?

Caltrans, in partnership with the University of California, Berkeley Partners for Advanced Transportation Technology program, reviewed several sites that experience regular congestion at peak hours and have recurrent bottlenecks. The researchers selected the Taylor Street intersection at State Route 87 in San Jose and collected site traffic data to calibrate a microscopic traffic system model to simulate the field operational test results prior to deployment. After achieving positive results in the simulation, the ramp meter controller and the arterial signal controller were linked and coordinated. The research team then analyzed the before-and-after traffic data to evaluate the effectiveness of the coordination strategy.

## WHAT WAS THE OUTCOME?

The data analysis indicated that the coordination strategy reduced the net delay at the Taylor Street intersection by 7%. The entrance ramp also had a higher flow, and the queue did not spill into the arterial. However, the freeway mainline traffic immediately upstream of the entrance ramp was unchanged. While the strategy improved traffic performance, it is also necessary to coordinate the freeway corridor, not just one entrance ramp, to improve mainline traffic.



Phase assignment and vehicle count on  
April 3, 2012 at the Taylor intersection

## WHAT IS THE BENEFIT?

It is possible to avoid bottlenecks by coordinating freeway ramp metering and arterial intersection traffic signals to regulate traffic flow onto the freeway. Optimizing traffic performance can be achieved with a practical, manageable coordination strategy, even with one intersection and one freeway entrance ramp. By maintaining traffic flow, idling is reduced and so are emissions. But to extend the improvements to the freeway mainline traffic, it is necessary to coordinate all the high-demand entrance ramps and relevant arterial intersections along a freeway corridor.

## LEARN MORE

To view the complete report:  
[www.dot.ca.gov/newtech/researchreports/reports/2013/final\\_report\\_task\\_2223.pdf](http://www.dot.ca.gov/newtech/researchreports/reports/2013/final_report_task_2223.pdf)



Sensor locations near SR 87 and Taylor Street